FLOOD INSURANCE STUDY

CITY OF SWEETWATER, TEXAS
NOLAN COUNTY

REVISED
JUNE 19, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER - 480502

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF SWEETWATER, NOLAN COUNTY, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the City of Sweetwater, Nolan County, Texas. This information will be used by the City of Sweetwater to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This study represents a revision of the original analyses prepared by Albert H. Halff Associates, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4648. The work for the original study was completed in October 1979. This revision was prepared by Dewberry & Davis, and was completed in September 1988.

1.3 Coordination

In March 1978, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the city, and Albert H. Halff Associates, Inc. (the study contractor) to determine the streams to be studied by detailed methods.

On April 16, 1980, a final CCO meeting was held with representatives of FEMA, the city, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Sweetwater, Nolan County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SWEETWATER, TX

(NOLAN CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

The following streams were studied by detailed methods: Wolf Hollow, from the downstream corporate limits to a point approximately 0.80 mile upstream; Stream SW-2, from its confluence with Wolf Hollow to a point approximately 60 feet upstream of 9th Street; and Town Creek, from the downstream corporate limits to a point approximately 60 feet upstream of Hill Street.

In this revision, the corporate limits were revised to include areas annexed by the City of Sweetwater. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Stream SW-1 and the remaining portions of Stream SW-2, Wolf Hollow, and Town Creek were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Sweetwater.

2.2 Community Description

The City of Sweetwater is located in the north-central portion of Texas in the northern portion of Nolan County, and is completely surrounded by the unincorporated areas of Nolan County. The total land area contained within its corporate limits is 6.6 square miles. It is situated approximately 40 miles west of Abilene and 65 miles northeast of Big Spring. The 1975 population of the city was 11,574 (Reference 1).

The City of Sweetwater is the county seat of Nolan County and the home of the annual West Texas Rattlesnake Roundup. The principal occupations are ranching and farming. Gypsum, sand, gravel, oil, and gas are mined nearby. The City of Sweetwater is on a divide with the water flowing to the east and northwest from the center of the city.

Wolf Hollow flows towards the northeast through the northern portion of the city. Its length is approximately 5.06 miles and its drainage area is 6.72 square miles.

Stream SW-2 is a tributary of Wolf Hollow and runs towards the northeast through the northern portion of the city. Its length is 2.65 miles and its drainage area is 1.79 square miles.

Town Creek is a stream flowing towards the southeast in the southeastern portion of the city. Its length is 2.47 miles and its drainage area is 2.26 square miles.

Stream SW-1 flows towards the northwest in the southwestern portion of the city. The stream is 1.61 miles in length and its drainage area is 1.39 square miles.

Approximately 70 percent of the city has been developed with the remainder vacant. Within the floodplains studied, development is limited to residences. The area is served mainly by Interstate Route 20 and the Atchison, Topeka and Santa Fe Railway.

The City of Sweetwater is located in the West Texas Rolling Prairies. Temperatures in winter and summer vary from 30 degrees Fahrenheit (^{o}F) to 96^{o}F. Average annual precipitation for the county is 22.2 inches (Reference 1).

2.3 Principal Flood Problems

The City of Sweetwater is located on a hill with the center of the city at the top of the hill. Basically, the streams radiate out from the center of the city. Discussions with long-time residents and a search of local records revealed that the city has not suffered from past flooding problems.

This study shows possible problems on Town Creek in the vicinity of Neff Street and Newman Street. Other possible areas of flooding problems are on Wolf Hollow in the vicinity of Crane Street and Stream SW-2 in the vicinity of 9th Street.

2.4 Flood Protection Measures

The City of Sweetwater follows a policy of maintenance on the streams within the city. Areas of siltation or heavy vegetation are periodically cleaned out as the need arises.

Nonstructural flood protection measures are also being used to aid in the prevention of future flood damage. These are in the form of land-use regulations adopted from the Code of Federal Regulations, which controls building within areas that have a high risk of flooding (Reference 2).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year

flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The flood-frequency discharge values for the streams studied by detailed methods were determined using a modification of the procedures outlined in the U. S. Geological Survey (USGS) Water-Resources Investigations 77-110 (Reference 3). The procedure relates basin characteristics to flood-frequency curves for basins in Texas. Flood-frequency curves for gaged streams were calculated using the log-Pearson Type III method outlined by the Water-Resources Council (References 4 and 5). The resulting flood-flow frequency curves are related by regression analysis to basin characteristics such as drainage area, stream length and slope (Reference 6). The resulting empirical equations for each flood-frequency are used for ungaged areas.

Flood-frequency discharges for areas studied by approximate methods were based on the same empirical equations used for areas studied by detailed methods.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WOLF HOLLOW					
At Santa Fe Lake	6.7	4,130	9,280	12,700	24,400
Downstream of Crane Street	6.2	4,300	9,300	12,400	22,700
Upstream of Stream SW-2	4.4	3,400	8,000	11,100	22,000
At Limit of Detailed Study	4.2	3,400	7,700	10,600	20,100
STREAM SW-2					
At confluence with Wolf Hollow	1.8	1,590	2,900	3,660	5,610
Downstream of 12th Street	1.1	1,240	2,100	2,540	3,330

TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TOWN CREEK					
At Limit of Detailed Study	2.3	1,492	2,576	3,146	4,260
Downstream of Alabama Avenue	1.7	1,621	2,562	3,021	3,358
Downstream of Neff Street	1.0	1,297	1,978	2,294	2,309

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis of Wolf Hollow, Stream SW-2, and Town Creek were obtained by field surveys. A 5-foot contour map, provided by the City of Sweetwater, was used to extend overbanks for cross sections that required extension (Reference 7). All bridges, dams, and culverts were field surveyed to obtain elevation and geometric data.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were calculated using the slope-area method.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of engineering judgment and field observation of the streams and floodplain areas. The channel "n" values for Wolf Hollow ranged from 0.060 to 0.050, and the overbank "n" values ranged from 0.080 to 0.050; channel "n" values and overbank "n" values for Stream SW-2 ranged from 0.080 to 0.030; and channel "n" values for Town Creek ranged from 0.070 to 0.020, and the overbank "n" values ranged from 0.100 to 0.030.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 9).

For the stream studied by approximate methods, the 100-year floodplain boundaries were delineated using normal depth calculations, topographic maps, and the Flood-prone Quadrangle Map for the City of Sweetwater (Reference 10).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic

gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Wolf Hollow								
A	4,200[1]	167	1,353	9.4	2,087.1	2,087.1	2,087.9	0.8
B	5,900[1]	551	6,216	2.0	2,099.2	2,099.2	2,099.2	0.0
C	7,680[1]	148	1,232	8.6	2,107.5	2,107.5	2,108.0	0.5
Stream SW-2								
A	1,620[1]	120	1,029	3.6	2,100.7	2,100.7	2,101.2	0.5
B	2,920[1]	165	1,330	2.8	2,106.0	2,106.0	2,107.0	1.0
C	5,830[1]	110	656	3.9	2,121.0	2,121.0	2,122.0	1.0
Town Creek								
A	1,520[2]	230	624	4.8	2,098.7	2,098.7	2,099.3	0.6
B	3,110[2]	175	389	7.8	2,107.2	2,107.2	2,108.0	0.8
C	4,420[2]	119	298	7.7	2,116.6	2,116.6	2,116.9	0.3

[1]Feet above mouth
[2]Feet above corporate limits

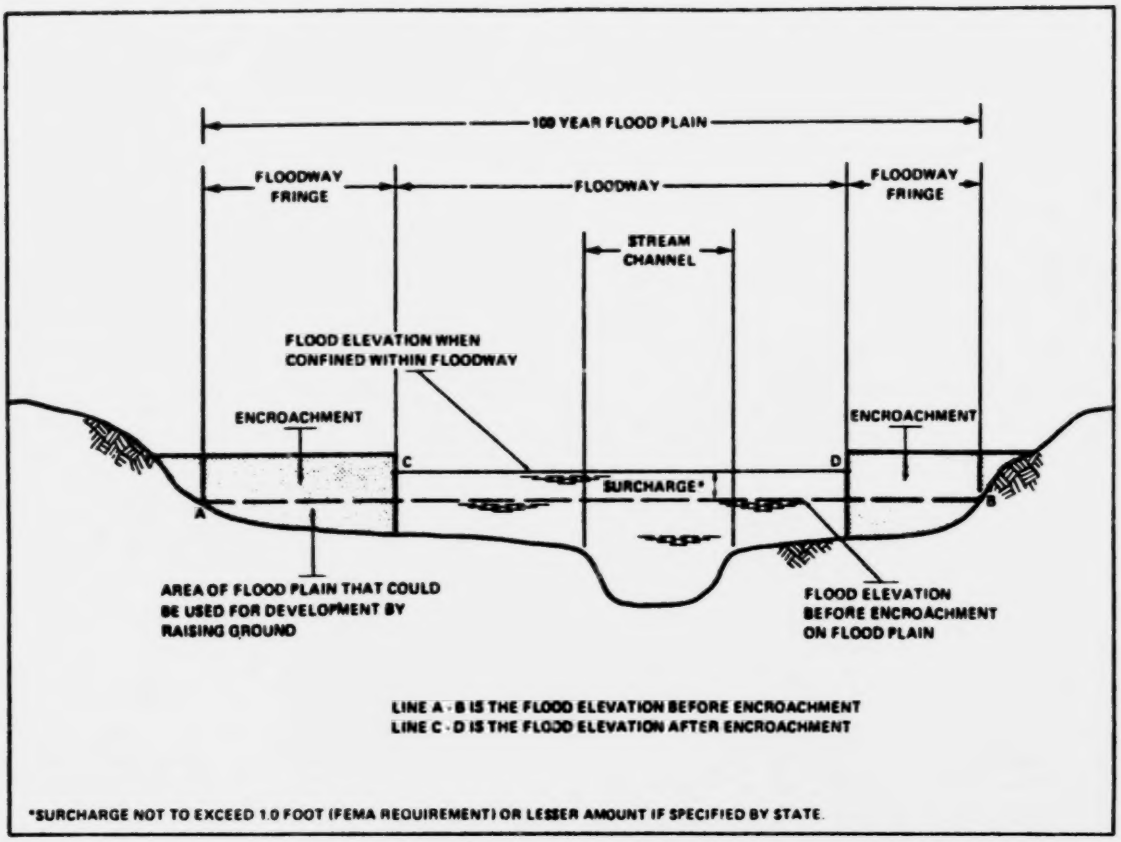
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SWEETWATER, TX
(NOLAN CO.)

FLOODWAY DATA

WOLF HOLLOW - STREAM SW-2 - TOWN CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A Flood Insurance Study is currently being prepared for the unincorporated areas of Nolan County (Reference 11). The results of that study will be in exact agreement with the results of this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201-3698.

9.0 BIBLIOGRAPHY AND REFERENCES

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2. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Code of Federal Regulations, Title 24, Chapter 10, Parts 1910.3A and 3B, Federal Register, Volume 41, No. 207, Revision 1976.

3. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 77-110, Estimating the Magnitude and Frequency of Floods in Texas by E. E. Schroeder and B. C. Massey, Washington, D. C., 1977.

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6. U. S. Department of the Interior, Geological Survey, Stream Flow Basin Characteristics, File Contents for Texas, Washington, D. C., Revised March 6, 1978.

7. Contour Map of the City of Sweetwater, Texas, Scale 1:1,500, Contour Interval 5 Feet: City of Sweetwater.

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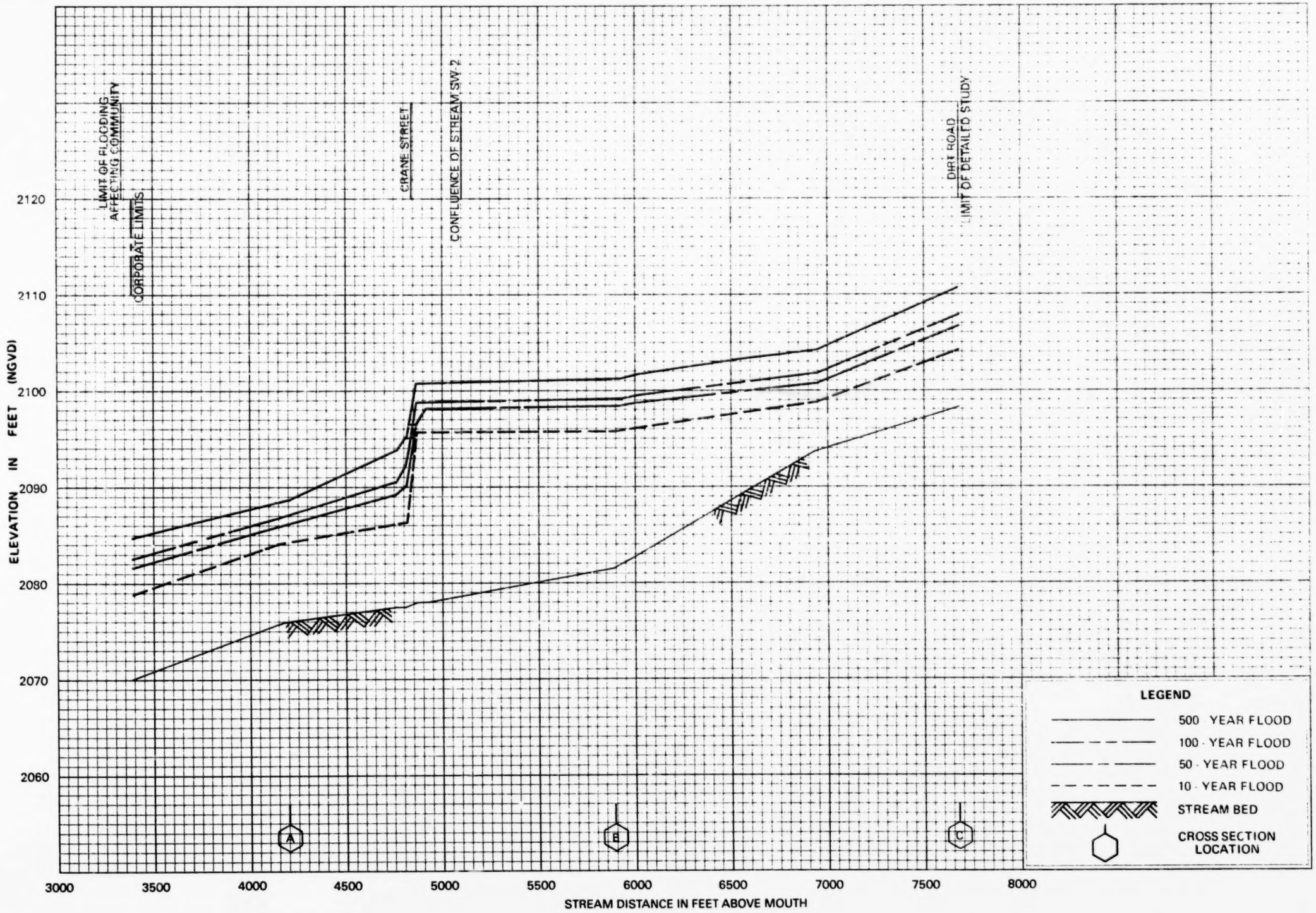
EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet NGVD)	Description of Location
RM 1*	2,072.80	Top of square nut on northwest corner of single-track wooden trestle over Wolf Hollow, on west side of golf course; approximately 1,200 feet northeast of intersection of Rose Avenue and 17th Street, and approximately 400 feet southeast of railroad yard.
RM 2*	2,077.18	60d nail in southwest corner of wooden railroad trestle over Wolf Hollow, approximately 550 feet northwest of 17th Street, approximtely 250 feet southeast of large metal building, approximately 150 feet southwest of extended centerline of Rose Avenue, and approximately 2,300 feet south of an abandoned railroad roundhouse.
RM 3	2,109.80	Cross mark on hex nut on northwest corner of base of traffic warning light on southeast corner of intersection of Crane Street and railroad track, approximately 1,700 feet east of Nolan County Fair Grounds building, and approximately 100 feet north of 17th Street.
RM 4	2,112.12	Railroad spike in utility pole No. 33721.2 on south side of 15th Street of T-intersection with Pecan Street.
RM 5	2,122.44	Cross mark on hex nut of fire hydrant on northwest corner of Walnut and 9th Streets.
RM 6	2,185.44	USC&GS disk stamped C-112 in square concrete pad on southeast corner of Post Office, 3rd and Locust Streets.
RM 7	2,120.29	Cross mark on top of curb on northwest corner of Neff and Alexander Streets.
RM 8	2,096.73	Cross mark in center of north headwall of culvert on Alabama Avenue crossing Town Creek, approximately 500 feet east of Newman Street.
RM 9	2,090.30	Cross mark on top of 4-inch southwest headwall of 36-inch reinforced concrete pipe crossing under Alabama Avenue, not more than 200 feet northwest of North Service Road of Interstate Route 20.

*Not shown on map; located outside corporate limits



FLOOD PROFILES

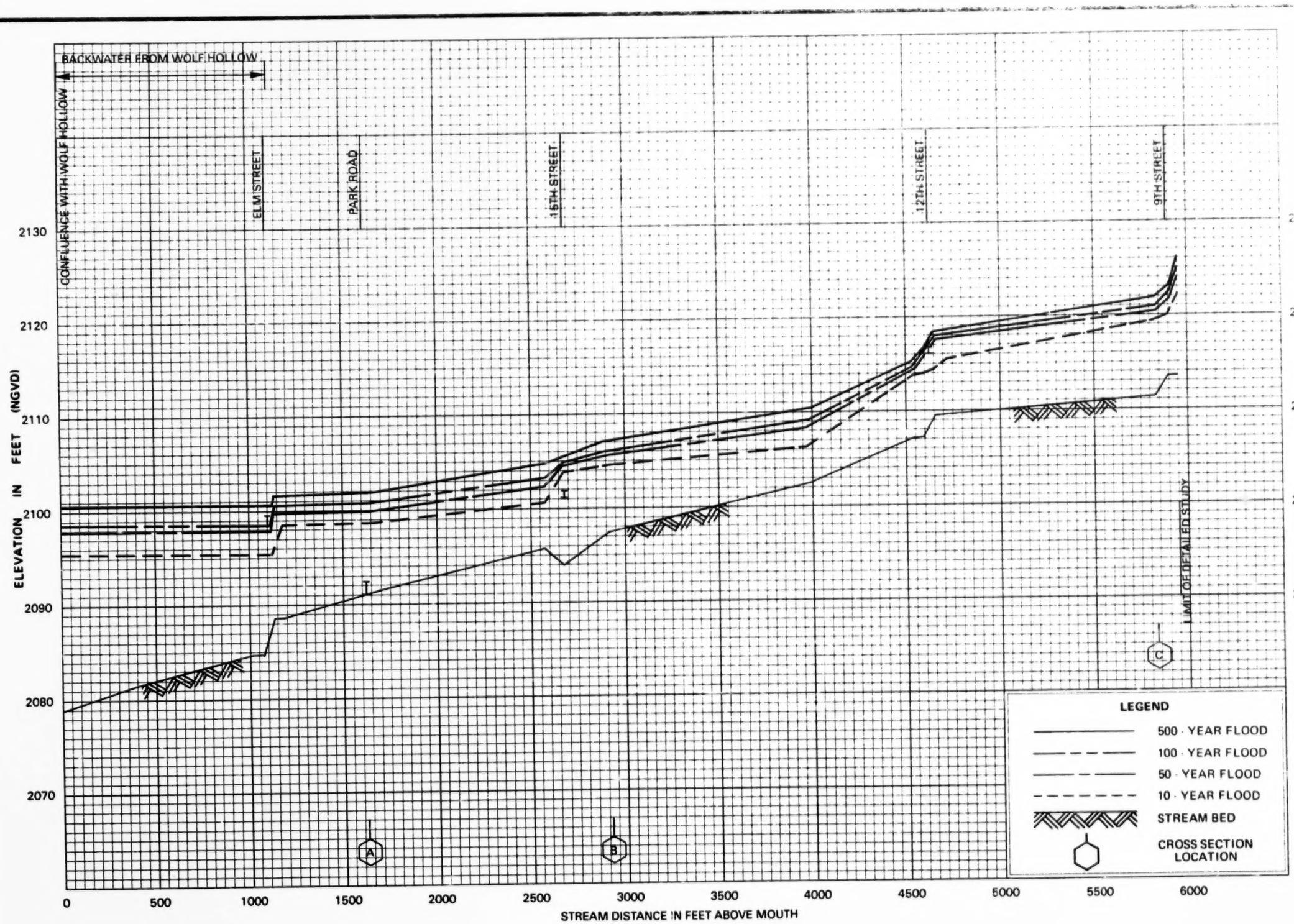
WOLF HOLLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SWEETWATER, TX

(NOLAN CO.)

01P



FLOOD PROFILES

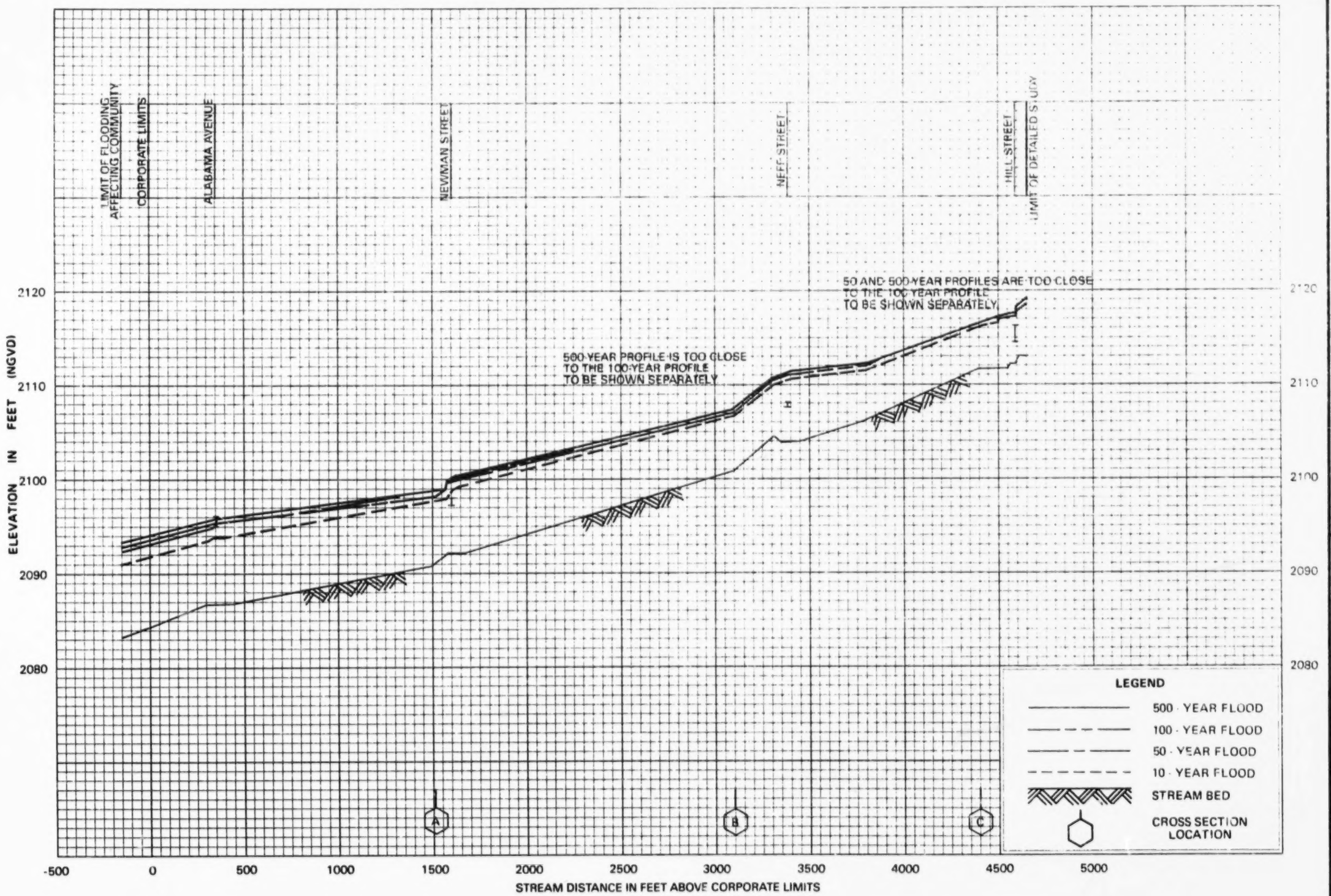
STREAM SW-2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SWEETWATER, TX

(NOLAN CO.)

02P



FLOOD PROFILES

TOWN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SWEETWATER, TX
(NOLAN CO.)

03P